

PATENT COOPERATION TREATY

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NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

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in its capacity as elected Office

Date of mailing (day/month/year)
08 March 2000 (08.03.00)

International application No.
PCT/GB99/02223

Applicant's or agent's file reference
1999P04827

International filing date (day/month/year)
26 July 1999 (26.07.99)

Priority date (day/month/year)
25 July 1998 (25.07.98)

Applicant

HAAS, Harald et al

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

13 January 2000 (13.01.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

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Facsimile No.: (41-22) 740.14.35

Authorized officer

Juan Cruz

Telephone No.: (41-22) 338.83.38

From the
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To:

KAY, ROSS M.
Siemens Shared Services Ltd.
Intellectual Property Department
Siemens House, Oldbury
Bracknell
GB-Berkshire RG12 8FZ
GRANDE BRETAGNE

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NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing
(day/month/year) 04.08.2000

Applicant's or agent's file reference
1999P04827

NO

P68

IMPORTANT NOTIFICATION

International application No.
PCT/GB99/02223

International filing date (day/month/year)
26/07/1999

Priority date (day/month/year)
25/07/1998

Applicant

SIEMENS AKTIENGESELLSCHAFT et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/



European Patent Office
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Tel. +49 89 2399 - 0 Tx: 523656 epmu d
Fax: +49 89 2399 - 4465

Authorized officer

Finnie, A

Tel. +49 89 2399-8251




PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 1999P04827		FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB99/02223	International filing date (day/month/year) 26/07/1999	Priority date (day/month/year) 25/07/1998	
International Patent Classification (IPC) or national classification and IPC H04Q7/36			
Applicant SIEMENS AKTIENGESELLSCHAFT et al.			
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 11 sheets.</p>			
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application 			
Date of submission of the demand 13/01/2000		Date of completion of this report 04.08.2000	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized officer Santacroce, J Telephone No. +49 89 2399 8804	



**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB99/02223

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)*:

Description, pages:

1-3,7-13	as originally filed			
4-6,6a-6b	as received on	07/06/2000	with letter of	01/06/2000

Claims, No.:

1-19	as received on	07/06/2000	with letter of	01/06/2000
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Drawings, sheets:

1/7-7/7	as originally filed
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2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB99/02223

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-19
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-19
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-19
	No:	Claims	

2. Citations and explanations

see separate sheet

Indications relating to item V (novelty, inventive step and industrial applicability)

1. The subject-matter of **claim 1** concerns a communications system.

The closest prior art is given by **US-A-5 732 076** which discloses an integrated communication system supporting multiple TDMA or TDD communication protocols (cited on page 6 of the description).

The problem addressed by the invention is that of matching the data handling capacity of communications system to the demands exerted by users, especially the asymmetric loadings that are encountered as a result of major downlink traffic.

Said problem has been solved by providing a communications system, according to claim 1, comprising a first duplexing technique (FDD) to enable communication between a first base station and a first plurality of terminals, a second duplexing technique (TDD) to enable communication between a second base station and a second plurality of terminals, wherein in order to increase the communications-handling capacity of the system, provision is made for detecting spare capacity in a frequency band associated with the FDD technique, and for allocating spare capacity so detected to support TDD communication between said second base station and one or more of said second plurality of terminals without interrupting contemporaneous FDD communication between said first base station and said first plurality of terminals.

The problem addressed by D1 differs considerably from the present invention and the solution adopted is therefore correspondingly different.

The problem addressed by D1 is that of mobile users who may leave the coverage region serviced by their provider but do not wish to carry several different handsets to enable them to communicate over communications systems operated by different providers. The solution according to D1 requires thus that data transmission for the two systems do not co-exist in the same time slot to avoid data collisions.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB99/02223

Claim 1 accordingly is considered novel and to involve an inventive step (Article 33 (2), (3) PCT).

2. Dependent **claims 2 to 15** contain further details of the system of claim 1. As they are dependent on claim 1, they also satisfy the requirements for novelty and inventive step (Article 33 (2), (3) PCT).

3. Independent **claim 16** corresponds for the category "method" to the system claimed in claim 1, therefore the same considerations as for claim 1 apply.

Independent claim 16 therefore satisfies the requirements for novelty and inventive step (Article 33 (2), (3) PCT).

4. The subject-matter of the independent **claims 17 and 18** concerns a terminal and a base station, respectively, for use in the system of claim 1.

Independent claims 17 and 18 therefore satisfy the requirements for novelty and inventive step (Article 33 (2), (3) PCT).

5. Dependent **claim 19** contains further details of the base station of claim 18. As it is dependent on claim 18, it also satisfies the requirements for novelty and inventive step (Article 33 (2), (3) PCT).

may not be run by the same operator. Hence, it should be understood that the term "system" is intended to include more than one communications system comprising at least one respective duplexing technique, or a single system comprising at least two duplexing techniques.

It is therefore an object of the present invention to obviate, or at least mitigate the above-described problems caused by asymmetry of telecommunications traffic.

According to a first aspect of the invention there is provided a communications system comprising a first duplexing technique to enable communication between a first base station and a first plurality of terminals, a second duplexing technique to enable communication between a second base station and a second plurality of terminals; the first and second base stations serving terminals in respective but at least overlapping areas and the first and second duplexing techniques having respective frequency bands associated therewith, characterised in that: the first duplexing technique comprises a Frequency Division Duplex (FDD) technique; the second duplexing technique comprises a Time Division Duplex (TDD) technique; and that, in order to increase the communications-handling capacity of the system, provision is made for detecting spare capacity in a frequency band associated with the FDD technique, and for allocating spare capacity so detected to support TDD communication between said second base station and one or more of said second plurality of terminals without interrupting contemporaneous FDD communication between said first base station and said first plurality of terminals.

According to a second aspect of the invention, there is provided a method of improving capacity in a communications system comprising a

first duplexing technique to enable communication between a first
base station and a first plurality of terminals, a second duplexing
technique to enable communication between a second base station and a
second plurality of terminals; the first and second base stations serving
5 terminals in respective but at least overlapping areas and the first and
second duplexing techniques having respective frequency bands
associated therewith, characterised by:
the first duplexing technique utilising Frequency Division Duplex
(FDD); the second duplexing technique utilising Time Division Duplex
10 (TDD); and by the steps of:

detecting spare capacity in a frequency band associated with the
FDD technique; and

allocating spare capacity so detected to support TDD
communication between said second base station and one or more of said
15 second plurality of terminals without interrupting contemporaneous FDD
communication between said first base station and said first plurality of
terminals.

According to a third aspect of the invention, there is provided a
terminal for use in a system comprising a first duplexing technique to
20 enable communication between a first base station and a first plurality of
terminals, a second duplexing technique to enable communication
between a second base station and a second plurality of terminals; the
first and second base stations serving terminals in respective but at least
overlapping areas and the first and second duplexing techniques having
25 respective frequency bands associated therewith, characterised by the
first duplexing technique comprising a Frequency Division Duplex
(FDD) technique; the second duplexing technique comprising a Time
Division Duplex (TDD) technique; and by the terminal being arranged

to receive an allocation of at least a portion of a frequency band associated with the first duplexing technique and to operate in accordance with the second duplexing technique within said frequency band associated with the first duplexing technique.

5 According to a fourth aspect of the invention, there is provided a base station for use in a system comprising a first duplexing technique to enable communication between another base station and a first plurality of terminals, the first-mentioned base station supporting a second duplexing technique for communication with a second plurality of terminals; the first and second base stations serving terminals in
10 respective but at least overlapping areas and the first and second duplexing techniques having respective frequency bands associated therewith, characterised by the first duplexing technique comprising a Frequency Division Duplex (FDD) technique; the second duplexing
15 technique comprising a Time Division Duplex (TDD) technique; and by the first-mentioned base station being arranged to allocate at least a portion of a frequency band associated with the first duplexing technique to a terminal so as to enable the terminal to operate in accordance with the second duplexing technique within said frequency band associated
20 with the first duplexing technique.

It is thus possible to provide an apparatus, a method of and a system for improving capacity in a communications network in which the capacity of the second base station can be increased by approximately 40% by converting unused radio resources of the first
25 base station when the load on the first base station is approximately 30%. Due to an increase in spectral efficiency, it is also possible to maintain a large guard time and hence increase the radius of the cell supported by the second base station. The increased spectral efficiency results in

higher data throughput and is achieved without filter adjustments to FDD terminals and base stations. Since minimal hardware and/or software modifications are necessary, the additional cost of implementing the present invention is minimal. Also, it is possible to assign different uplink and downlink capacities for a given terminal in the TDD cell, thereby obviating the need to change the switching point of the TDD cell. Also, asynchronous overlap with adjacent TDD cells is prevented.

Other, preferred, features and advantages are set forth in, and will become apparent from, the following description and accompanying dependent claims.

It is known, from US-A-5 732 076, to share capacity between systems operated in accordance with differing mobile communications protocols. However, the arrangement disclosed therein aims principally to promote user mobility between different communication systems without the need to purchase several sets of hardware, and moreover requires the different systems to operate in totally separate and non-overlapping time slots, thereby placing considerable demands upon synchronisation controls used to closely interleave the time slots of the two systems, so as to avoid collisions, and rendering the user capacity dependent upon time slot availability.

At least one embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 3 is a schematic diagram of mobile terminals and base stations constituting an example of the invention;

Figure 4 is a schematic diagram of bandwidth allocation for the example of Figure 3;

Figure 5 shows, in more detail, the use of bandwidth allocated to a TDD technique in Figure 4;

Figure 6 is a schematic diagram of bandwidth use constituting an embodiment of the invention; and

5 Figure 7 is a graph illustrating improved system performance due to the embodiment of Figure 6.

Throughout the description, identical reference numerals will be used to identify like parts.

In a first embodiment of the invention, a UMTS 300 (Figure 3)
10 comprises an FDD cell 302 supported by the FDD base station 106. A first TDD micro-cell 306, a second TDD micro-cell 308 and a third TDD micro-cell 310 are located substantially within the FDD cell 302 and are supported by a first TDD base station 116, a second TDD base station 314 and a third

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CLAIMS

1. A communications system comprising a first duplexing technique (100) to enable communication between a first base station (106) and a first plurality of terminals (104, 318), a second duplexing technique (102) to enable communication between a second base station (116) and a second plurality of terminals (114, U1, U2,.....Un); the first and second base stations (106, 116) serving terminals in respective but at least overlapping areas (302; 306, 308, 310) and the first and second duplexing techniques (100, 102) having respective frequency bands (108, 110; 118) associated therewith, characterised in that: the first duplexing technique (100) comprises a Frequency Division Duplex (FDD) technique; the second duplexing technique (102) comprises a Time Division Duplex (TDD) technique; and that, in order to increase the communications-handling capacity of the system, provision (404) is made for detecting spare capacity (400, 402) in a frequency band (108) associated with the FDD technique (100), and for allocating spare capacity so detected to support TDD communication between said second base station (116) and one or more of said second plurality of terminals (U1) without interrupting contemporaneous FDD communication between said first base station (106) and said first plurality of terminals (104, 318).

2. A system as claimed in Claim 1, wherein a first multiple access scheme is associated with the first duplexing technique.

3. A system as claimed in Claim 1, wherein a second multiple-access scheme is associated with the second duplexing technique.

4. A system as claimed in Claim 2, wherein the first multiple access scheme is one of: Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA), Space Division Multiple Access (SDMA) or Frequency Division Multiple Access (FDMA).
5. A system as claimed in Claim 3, wherein the second multiple access scheme is one of: Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA), Space Division Multiple Access (SDMA) or Frequency Division Multiple Access (FDMA).
6. A system as claimed in any preceding claim, wherein at least a portion (110) of the frequency allocation of the first duplexing technique (100) is used to transmit FDD downlink traffic during substantially all time slots associated with the second duplexing technique (102).
7. A system as claimed in any preceding claim, wherein a terminal (U1) operating in accordance with the second duplexing technique within the band (108) of frequencies allocated to the first duplexing technique is arranged to transmit delay-tolerant data.
8. A system as claimed in any preceding claim, wherein a terminal (U1) operating in accordance with the second duplexing technique within the band (108) of frequencies allocated to the first duplexing technique is arranged to receive delay-tolerant data.
9. A system as claimed in Claim 7 or Claim 8, wherein the delay-tolerant data is packet data.

10. A system as claimed in any preceding claim, wherein the means (404) provided for allocating spare capacity is arranged to determine a band (400, 402) of frequencies within a respective frequency band (108, 110) associated with the first duplexing system (100) on the basis of mutual interference criteria.
11. A system as claimed in Claim 10, wherein the means (404) provided for allocating spare capacity employs a dynamic channel allocation algorithm in order to evaluate said mutual interference criteria.
12. A system as claimed in Claim 3, wherein the second multiple access scheme has a guard time (tg), the terminal (U1) being arranged to use any capacity available in the band of frequencies associated with the first duplexing technique (100) during the guard time.
13. A system as claimed in any preceding claim, wherein the second base station (116) is located between about 200 and 500m from the first base station (106).
14. A system as claimed in any preceding claim, wherein the second plurality of terminals (114, U1, U2,.....Un) includes the terminal (U1).
15. A system as claimed in any of claims 1 – 13, wherein the terminal (Un+1) is a new terminal previously unaffiliated to the second base station (116).

16. A method of improving capacity in a communications system comprising a first duplexing technique (100) to enable communication between a first base station (106) and a first plurality of terminals (104, 318), a second duplexing technique (102) to enable communication
5 between a second base station (116) and a second plurality of terminals (114, U1, U2,.....Un); the first and second base stations (106, 116) serving terminals in respective but at least overlapping areas (302; 306, 308, 310) and the first and second duplexing techniques (100, 102) having respective frequency bands (108, 110; 118) associated therewith,
10 characterised by:

the first duplexing technique (100) utilising Frequency Division Duplex (FDD);

the second duplexing technique (102) utilising Time Division Duplex (TDD); and by the steps of:

15 detecting spare capacity (400, 402) in a frequency band (108) associated with the FDD technique (100); and

allocating spare capacity so detected to support TDD communication between said second base station (116) and one or more of said second plurality of terminals (U1) without interrupting
20 contemporaneous FDD communication between said first base station (106) and said first plurality of terminals (104, 318).

17. A terminal for use in a system comprising a first duplexing technique (100) to enable communication between a first base station
25 (106) and a first plurality of terminals (104, 318), a second duplexing technique (102) to enable communication between a second base station (116) and a second plurality of terminals (114, U1, U2,.....Un); the first and second base stations (106, 116) serving terminals in respective but at

least overlapping areas (302; 306, 308, 310) and the first and second
duplexing techniques (100, 102) having respective frequency bands (108,
110; 118) associated therewith, characterised by the first duplexing
technique (100) comprising a Frequency Division Duplex (FDD)
5 technique; the second duplexing technique (102) comprising a Time
Division Duplex (TDD) technique; and by the terminal (U1; Un+1)
being arranged to receive an allocation of at least a portion (400, 402) of
a frequency band (108) associated with the first duplexing technique
(100) and to operate in accordance with the second duplexing technique
10 (102) within said frequency band (108) associated with the first
duplexing technique (100).

18. A base station (116) for use in a system comprising a first
duplexing technique (100) to enable communication between another
15 base station (106) and a first plurality of terminals (104, 318), the first-
mentioned base station (116) supporting a second duplexing technique
(102) for communication with a second plurality of terminals (114, U1,
U2,.....Un); the first and second base stations (106, 116) serving
terminals in respective but at least overlapping areas (302; 306, 308, 310)
20 and the first and second duplexing techniques (100, 102) having
respective frequency bands (108, 110; 118) associated therewith,
characterised by the first duplexing technique (100) comprising a
Frequency Division Duplex (FDD) technique; the second duplexing
technique (102) comprising a Time Division Duplex (TDD) technique;
25 and by the first-mentioned base station being arranged to allocate at least
a portion (400, 402) of a frequency band (108) associated with the first
duplexing technique (100) to a terminal (U1) so as to enable the terminal
(U1) to operate in accordance with the second duplexing technique (102)

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within said frequency band (108) associated with the first duplexing technique (100).

19. A base station as claimed in Claim 18, further comprising
- 5 frequency allocation means (404) for allocating said at least a portion (400, 402) of the frequency band (108) associated with the first duplexing technique (100).



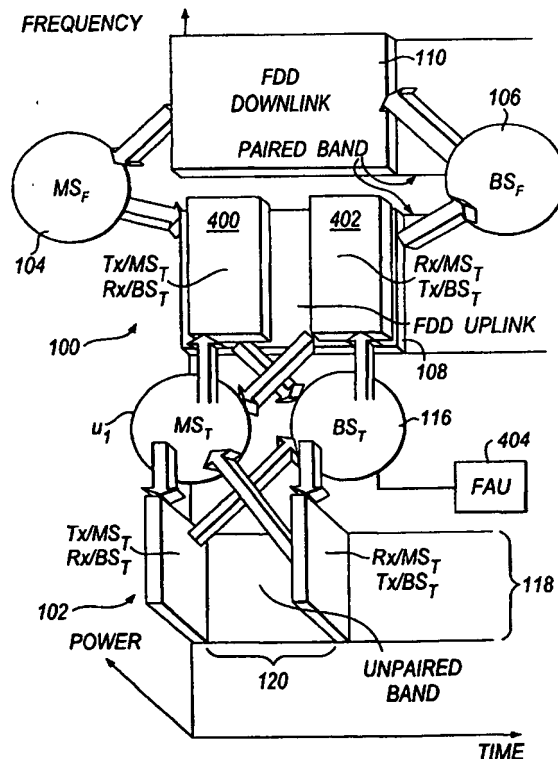
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(21) International Application Number: PCT/GB99/02223 (22) International Filing Date: 26 July 1999 (26.07.99) (30) Priority Data: 9816207.6 25 July 1998 (25.07.98) GB (71) Applicant (for all designated States except US): SIEMENS AKTIENGESELLSCHAFT [DE/DE]; Hofmannstrasse 51, D-81369 München (DE). (72) Inventors; and (75) Inventors/Applicants (for US only): HAAS, Harald [DE/GB]; 42 Craigmillar Park, Edinburgh EH16 5PS (GB). POVEY, Gordon, Johnston, Robertson [GB/GB]; 3 Forbes Terrace, Salisbury Street, Kirkcaldy KY2 5HW (GB). (74) Agent: KAY, Ross, M.; Siemens Group Services Limited, Intellectual Property Dept., Siemens House, Oldbury, Bracknell, Berkshire RG12 8FZ (GB).		(81) Designated States: AU, CN, JP, KR, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published With international search report.

(54) Title: APPARATUS, METHOD OF AND SYSTEM FOR IMPROVING CAPACITY IN A COMMUNICATIONS NETWORK

(57) Abstract

In a telecommunications system (300), such as the Universal Mobile Telecommunications System (UMTS), a first duplexing technique (100) and a second duplexing technique (102) are employed. Bands of frequencies (108, 110, 118) are allocated to each duplexing technique (100, 102). However, due to asymmetry of telecommunications traffic, it is known that loading of the band of downlink frequencies (110) of the first duplexing technique (100) is likely to be high, whereas the loading of the band of uplink frequencies (108) of the first duplexing technique (100) is likely to be relatively low. Similarly, the loading associated with the second duplexing technique (102) is likely to be biased towards downlink telecommunications traffic. Consequently, the invention provides for frequency assignment means arranged to allocate at least a portion of a frequency band (400, 402) allocated to the first duplexing scheme (100) to a terminal so as to enable the terminal to operate in accordance with the second duplexing scheme (102) in the frequency band (400, 402) allocated to the first duplexing scheme (100).



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